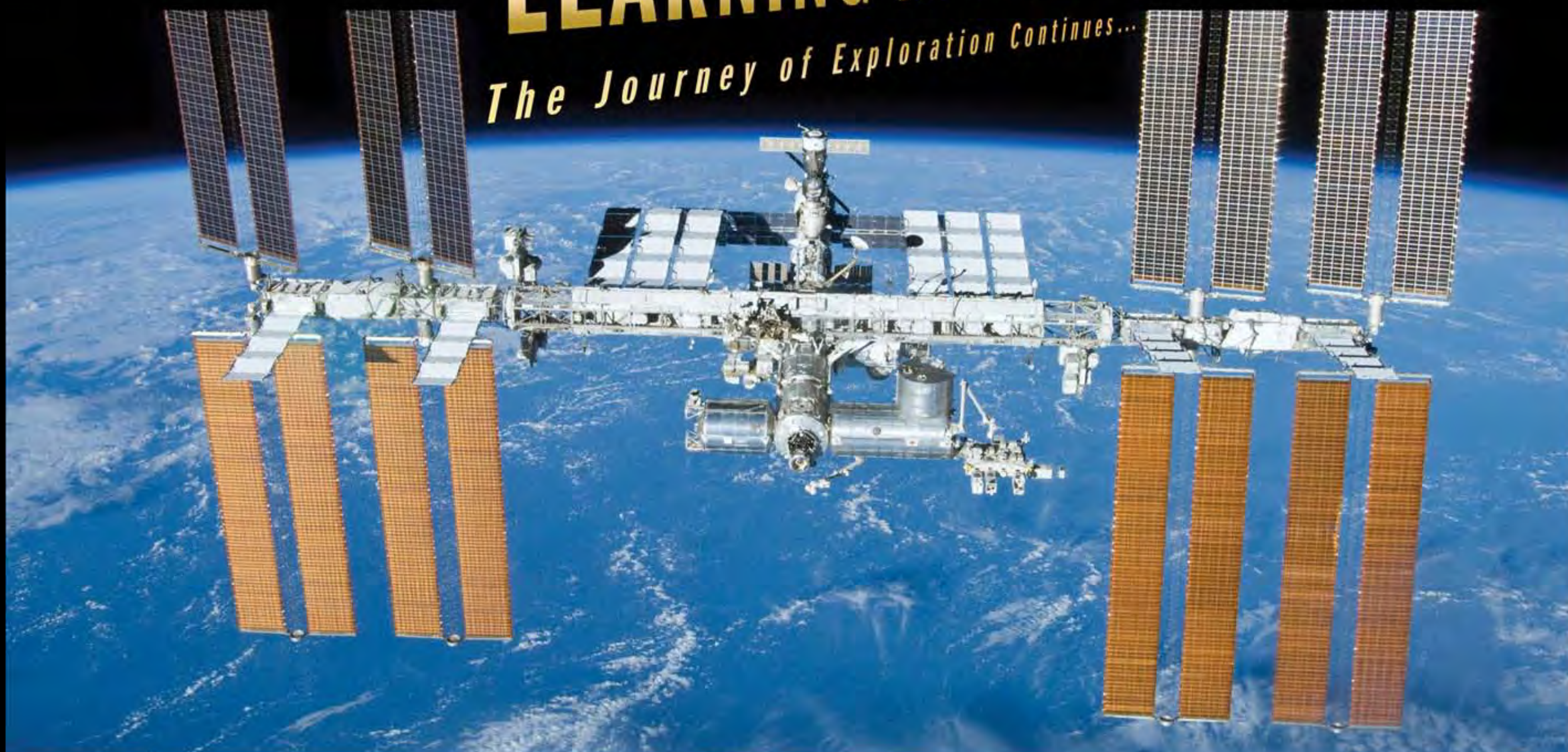
National Aeronautics and Space Administration

INTERNATIONAL SPACE STATION

LEARNING IN SPACE

The Journey of Exploration Continues...



www.nasa.gov

National Aeronautics and Space Administration

International Space Station Partners

Objective

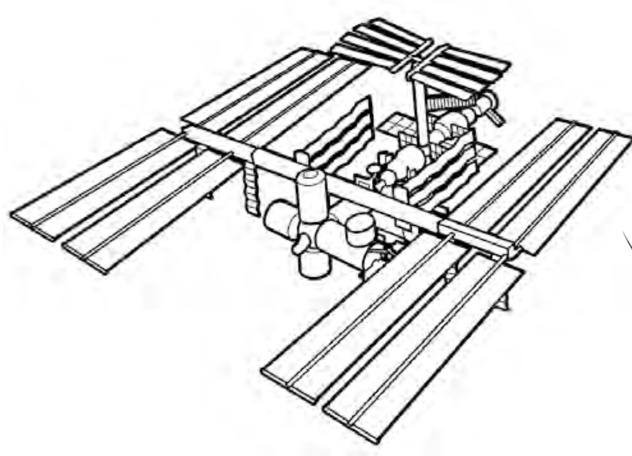
To identify the international partnerships involved in the development and operation of the International Space Station (ISS).

Description

Students use geography research skills to help them learn about the sixteen partner countries that support the International Space Station. They first identify and color the flags of the partner nations then locate those countries on a political map. Additionally, students use lines of latitude to determine which of these countries the ISS flies over as it orbits Earth and why doing so may be important to each nation.

Materials

- **World map or atlas (including political boundaries)**
- **Fine tip color markers or color pencils**
- **World globe**
- **Copies of Student Data Sheets**



EW-2010-09-00010-SSC

Background

The ISS travels from west to east as it orbits Earth. Its orbit is tilted or inclined to the equator, enabling it to pass over a large portion of Earth's surface while Earth rotates beneath it. This allows for better communications and Earth surface observations. As a result, the ISS eventually passes directly over all Earth's surface between 51.6 degrees north latitude and 51.6 degrees south latitude during its successive orbits.

Procedure

1. Have students read the *International Space Station (ISS) Basics* information sheet to learn about the ISS, its international partners, construction, components and mission. The students will use the *Student Data Sheet* to record their answers for this activity.
2. The *International Space Station Partner Nation Flags* page has black and white representations of the flags of the sixteen ISS partner nations. Have the students research these flags using an atlas or the internet then color the flags their proper colors using fine tip markers or colored pencils. **Note:** A suggested U.S. government web site that is safe for the students to use for this research is: https://www.cia.gov/library/publications/the-world-factbook/index.html
3. Have the students use a world map with political boundaries to locate the sixteen ISS partner nations on the *World Map*. Students will label the countries on the *World Map* using the corresponding numbers for each country listed on the *Student Data Sheet*. Because some of the European countries will be too small to locate and identify on the *World Map*, students should locate and identify them on the *Europe Map*.
4. Have the students estimate the location of 51.6 degrees *north* latitude on the *World Map* page, and draw a dark east-west line along this latitude. They should repeat this procedure for 51.6 degrees *south* latitude. The students should then identify each partner country the ISS flies over as it orbits Earth by circling the name of each country in the provided list on the *Student Data Sheet*. Have them discuss why they think it is beneficial for the ISS to orbit over so much of Earth's surface and record their answer on the *Student Data Sheet* question 8.

Assessment

Review the student activity pages and discuss the answers with the class.

Extensions

1. Have the students cut out one set of colored flags and pin or tape them on the correct countries on a political wall map of the world. Students can make flagpoles for each flag using toothpicks.
2. Have the students discuss why there are sixteen partner nations involved with the ISS. Should there be less or more countries involved? They should be able to support their answers.
3. Show how the ISS orbits Earth by having one student hold up a world globe and another hold up a Hula Hoop. Place the hoop around the globe and tilt it at an approximate 52-degree angle. Point out how the orbit is angled to Earth's equator. Next, have the student spin the globe slowly. Use a finger to trace the shape of the hoop. Each time the finger crosses the equator it will do so at a different geographic location.

Standards

National Science Education Standards

Science as Inquiry

- Abilities necessary to do scientific inquiry
- Understanding scientific inquiry

Science in Personal and Social Perspectives

- Science and technology in society

History and Nature of Science

- Science as a human endeavor

National Geography Standards

The World in Spatial Terms

- How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective
- How to use mental maps to organize information about people, places, and environments in a spatial context

The Uses of Geography

- How to apply geography to interpret the present and plan for the future

Name: ______________________________________

International Space Station Partners
Student Data Sheet

1. Read the *International Space Station (ISS) Basics* information sheet to learn about the ISS and international partners, construction, components and mission. More info on the ISS can be found at http://www.nasa.gov/station/.

2. The International Space Station is an international partnership of sixteen countries. *The International Space Station Partner Nations Flags* page has black and white drawings of the flags of the sixteen ISS partner nations. Research these flags and color them their proper colors using fine tip markers or colored pencils.

3. Label the sixteen ISS partner nations on the *World Map*. Use a world map with political boundaries as reference to identify each country. The *Europe Map* will assist you in locating and identifying the smaller European countries. Label the *World Map and Europe Map* countries by writing the corresponding number for each country, listed below, on the correct country.

1. Belgium	**5. England**	**9. Japan**	**13. Spain**
2. Brazil	**6. France**	**10. Netherlands**	**14. Sweden**
3. Canada	**7. Germany**	**11. Norway**	**15. Switzerland**
4. Denmark	**8. Italy**	**12. Russia**	**16. United States**

4. Estimate the location of 51.6 degrees ***north*** latitude on the *World Map* page and draw a dark line along this latitude. Repeat this procedure for 51.6 degrees ***south*** latitude. The area of Earth between these lines of latitude is where the ISS will pass over as it orbits. Locate each partner country the ISS flies over on the map. As you find each country, keep track by circling its name in the list above, using a red pencil or marker.

5. Which of the ISS Partner countries does the ISS orbit directly over? Which countries does it miss? Draw an X on the countries in #3 the ISS does not fly directly over, using a black pencil or marker.

6. How did you determine which countries it misses? (use a separate sheet of paper if needed)

   ____

   ____

7. If you were building your own space station, which countries would you invite as partners and why? (use a separate sheet of paper if needed)

   ____

   ____

8. Why is it beneficial for the ISS to orbit over so much of Earth's surface? (use a separate sheet of paper if needed)

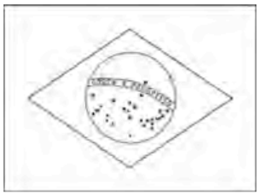
   ____

   ____

Name: ____

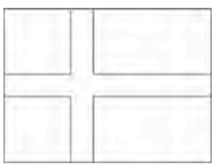
International Space Station Partner Nations Flags

1. Belgium

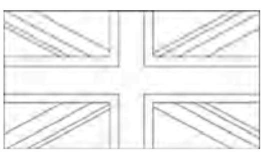


2. Brazil

3. Canada

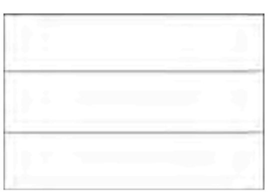


4. Denmark

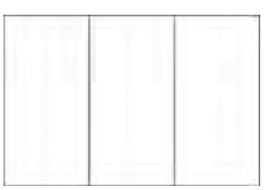


5. England

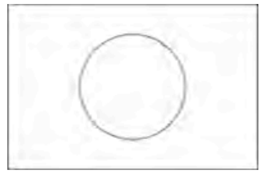
6. France



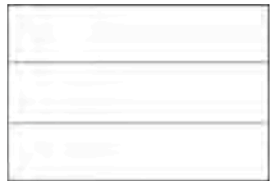
7. Germany



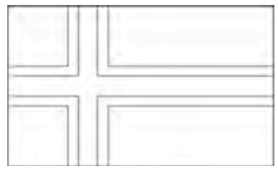
8. Italy



9. Japan

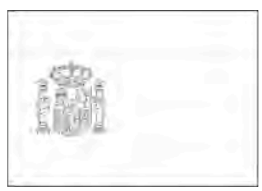


10. Netherlands

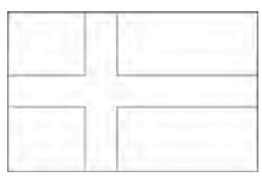


11. Norway

12. Russia

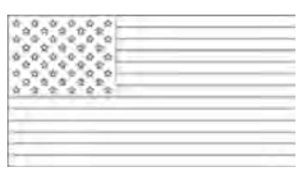


13. Spain



14. Sweden

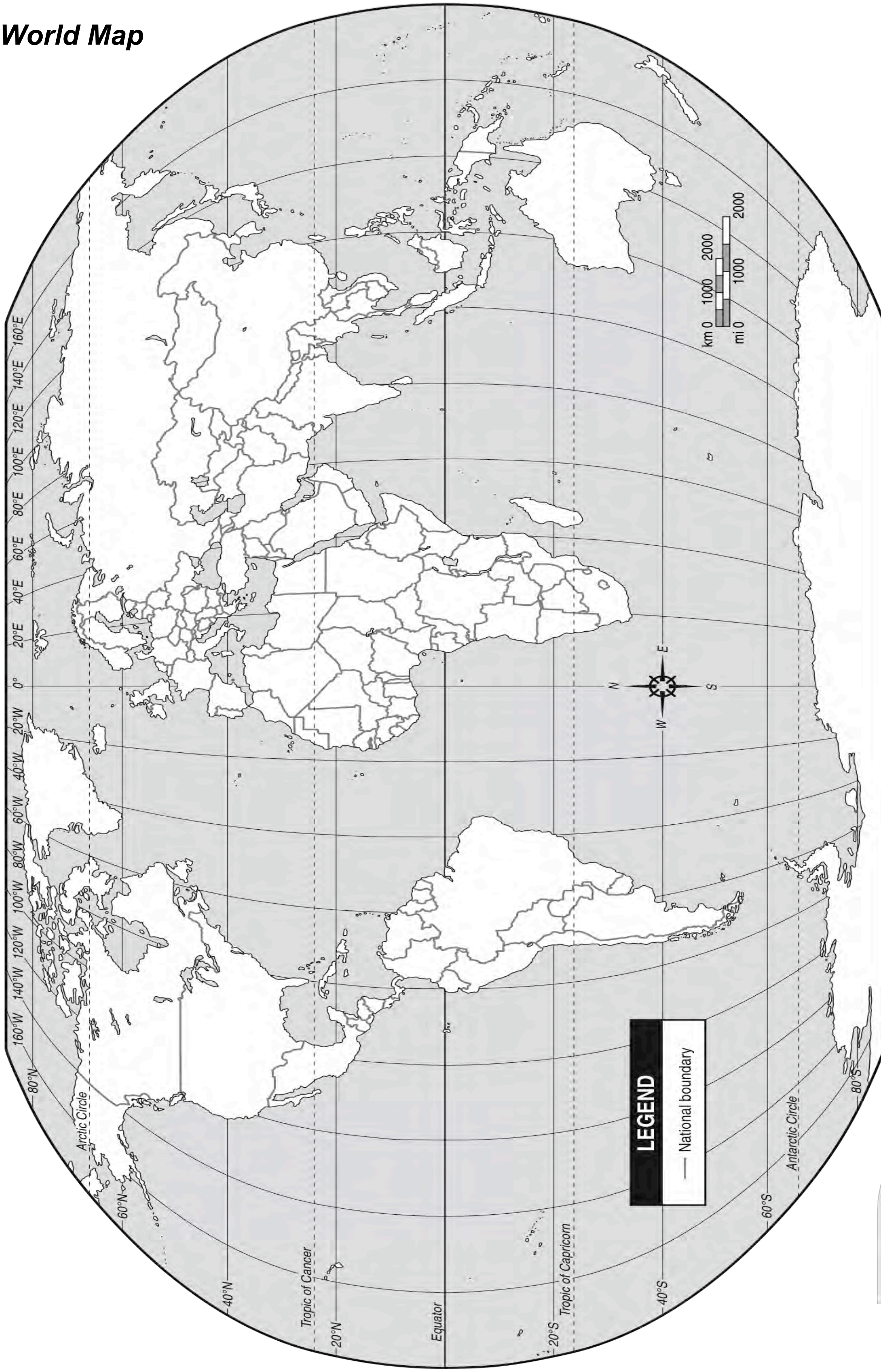
15. Switzerland



16. United States

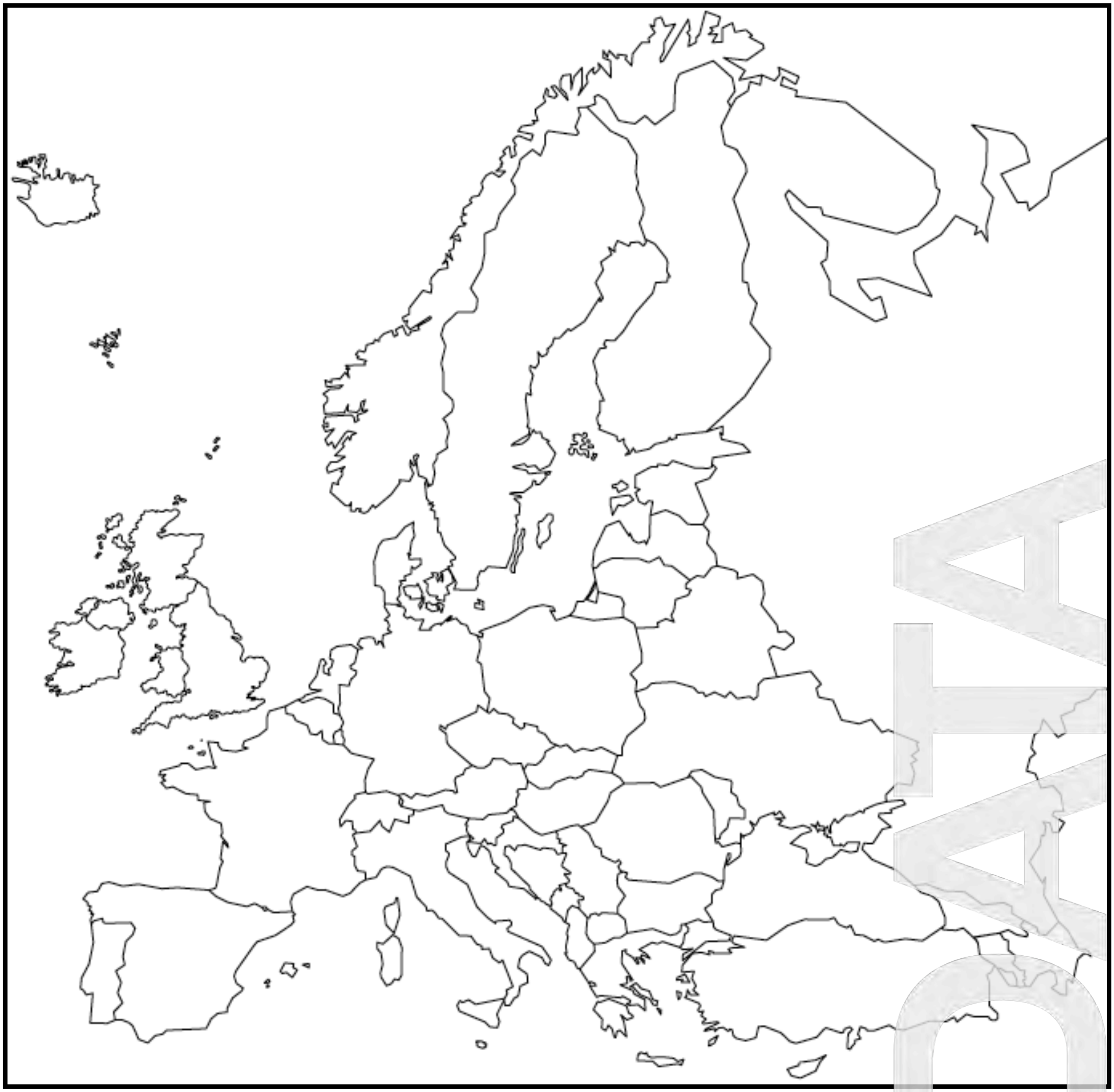
Name: ____________________________________

World Map



Name: ___________________________________

Europe Map



International Space Station (ISS) Basics

(excerpt from NASA Fact Sheet FS-2009-01-002-JSC)

Clearly visible with the naked eye in the night sky, the expansive International Space Station is a working laboratory orbiting 240 statute miles (386.24 kilometers) above the Earth traveling at 17,500 miles per hour (32,410 kilometers per hour) and is home to an international crew.

It is the most complex scientific and technological endeavor ever undertaken, involving support from five space agencies representing 16 nations. Once completed, this research outpost in space will include contributions from the U.S., Canada, Japan, Russia, Brazil, Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland, and the United Kingdom.

As a research outpost, the station is a test bed for future technologies and a research laboratory for new, advanced industrial materials, communications technology, medical research, and much more.

On-orbit assembly began in 1998 with the launch of Zarya, and once completed will provide crew members with more than 33,000 cubic feet (935 cubic meters) of habitable volume – almost equal to one and a half Boeing 747 jetliners – and will weigh 925,000 pounds (419,600 kilograms). It will measure 361 feet (110.03 meters) end to end, which is equivalent to a U.S. football field, including the end zones. The station's solar panels exceed the wingspan of a Boeing 777 jetliner and harness enough energy from the sun to provide electrical power to all station components and scientific experiments.

The station now includes the Russian-built Zarya Module and the Zvezda Service Module, which contain the station's living quarters and life-support systems; the U.S.-built Unity Connecting Module, providing docking ports for several station components; the U.S.-built Destiny Laboratory, which expands the station's scientific capabilities with experiment compartments that allow nearly continuous scientific research and provide additional life-support and robotic capabilities; the U.S.-built Quest Airlock, a doorway to space that supports station-based spacewalks; the European-built Columbus Module with its capacity to support up to 10 interior experiment racks as well as four exterior payload platforms; the Japanese-built Kibo Experiment Module consisting of 23 experiment racks and a storage module; the Italian-built Harmony Node 2 that increases crew living and working space, provides a passageway between the U.S. Destiny Laboratory, the Japanese Experiment Module, and the European Columbus Module and also provides connecting ports for supply vehicles and the space shuttle; the Canadian-built Mobile Servicing System that consists of the Canadarm2, a new-generation robotic arm that gives the station a movable space crane, the Special Purpose Dexterous Manipulator, or Dextre, a smaller two-armed robot capable of handling the delicate assembly tasks currently handled by astronauts during spacewalks, and the Mobile Base System, a work platform that moves along rails covering the length of the space station and provides lateral mobility for the Canadarm2 as it traverses the main trusses; the Russian-built Pirs docking compartment, which adds additional spacewalking and docking capabilities to the station; and the Integrated Truss Structure, which is composed of multiple elements and forms the backbone of the station.

The station's first resident crew, Expedition 1, marked the beginning of a permanent international human presence in space, arriving at the station in a Russian Soyuz capsule in November 2000. Currently, station crews stay on orbit for six months at a time. The International Space Station provides the first laboratory complex where gravity, a fundamental force on Earth, is virtually eliminated for extended periods. This ability to control the variable of gravity in experiments opens up unimaginable research possibilities. The International Space Station is vital to human exploration. It's where we're learning how to combat the physiological effects of being in space for long periods. It's our test bed for technologies and our decision-making processes when things go as planned and when they don't. It's important to learn and test these things 240 statute miles (386.24 kilometers) up rather than encountering them 240,000 miles (386,242 kilometers) away while on the way to Mars or beyond.

The International Space Station, an unprecedented, state-of-the-art, orbiting laboratory complex, continues to expand the boundaries of space research. The unique capabilities of its laboratories will lead to discoveries that will benefit missions farther into outer space. These discoveries will also benefit people all over the world, now and for the future.

Completion of the International Space Station is one of the first steps toward NASA's newest exploration goals. Using the station to study human endurance in space and to test new technologies and techniques, NASA will prepare for the longer journeys to the moon, Mars, and beyond.

Explore these websites for information on NASA missions and education resources:

NASA Home
www.nasa.gov

NASA Education
education.nasa.gov

International Space Station (ISS)
www.nasa.gov/station

NASA Educator Resource Center Network
www.nasa.gov/education/ercn

NASA Teaching From Space
www.nasa.gov/education/tfs

NASA Digital Learning Network (DLN)
dln.nasa.gov

NASA TV
www.nasa.gov/multimedia/nasatv/

NASA Central Operations of Resources for Educators (CORE) core.nasa.gov

NASA Careers
www.nasa.gov/education/careers

NASA *Mass vs. Weight* curriculum
education.ssc.nasa.gov/massvsweight.asp

About the image on the reverse side:
The image of the International Space Station (ISS) was taken by astronauts aboard the space shuttle Atlantis as it flew around the ISS during the STS-132 mission in May 2010. The sixteen flags represent the international cooperation of the nations that are partners in the ISS program.